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The effect of knowledge about Artificial Intelligence (AI) on openness towards AI-enabled products and services:

Examining whether customer beliefs about the efficiency, convenience, privacy protection and data security of AI-enabled products and services mediate this effect

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Abstract

Artificial Intelligence **("AI")** is a rapidly evolving technology and is currently the most promising market opportunity in the world economy. The study examines the relationship of customers knowledge about AI with their openness to interact with AI-enabled products/services. The author analyzes whether customer beliefs about efficiency, convenience, privacy protection and data security act as a mediator of this relationship. Analyzing primary data (n = 331) through regression models, the study suggests that the significant relationship between knowledge and openness is partially mediated by customer beliefs, and they additionally have a significant direct relationship with openness. Implications for governments and businesses are derived.

Keywords: *Artificial Intelligence, Knowledge, Customer Beliefs, Openness*

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1 Introduction

1.1 Background

Companies have been widely adopting **Artificial Intelligence** (abbreviated as "AI") solutions in the past years with the trend still growing. Recent studies show that compared to today, cumulative global Gross Domestic Product ("GDP") could increase 16% by 2030, due to AI deployment in the global economy – this is an equivalent of US$13 trillion or 1.2% of additional GDP growth per year. As such, AI is currently the most promising market opportunity in the global economy (Manyika, Chui, and Joshi, 2018). This development is driven by three major areas – productivity gains resulting from (1) business process automation and (2) businesses augmenting their workforce with AI technologies, as well as (3) increased customer demand for AI-enabled products and services of superior quality (Verweij and Rao, 2017). Cam, Chui, and Hall (2019) show that compared with the previous year, AI usage in business processes has increased by nearly 25%.

While AI can improve the efficiency and productivity of organizations, it can also transform products, and the way services are delivered. As such, AI can change entire product and service lines, in a variety of industries, ranging from autonomous driving to diagnostics and surgeries. Eventually, AI will be capable of diagnosing diseases before they appear and perform surgeries better than humans (Daley, 2019; Edelman, 2019; Kaminsky, 2019). Considering the Financial Services industry, AI algorithms have the capability to determine personalized prices for customers of insurance products or virtual AI-driven assistants can better explain developments in ones invested portfolio and the financial market than a human advisor (Edelman, 2019). What these examples have in common, is the proximity to customers – the customer must interact with AI directly or indirectly. Aiming to stay competitive and be at the forefront of innovation in the field of AI, this forces organizations to react and understand which factors influence their customers' openness to interact with AI-driven products and services.

As the concept of AI lacks a uniform definition, customers are conflicted about the meaning and their beliefs about AI. Several surveys found that expectations and beliefs about AI differ amongst customers with more or less knowledge about the technology. While the views of survey participants with more knowledge about AI tend to be relatively upbeat, participants who do not have an understanding of the core of AI, frequently associate less positive outcomes with AI usage (Weber Shandwick, 2016; Pega, 2017; Buvat et al., 2018).

1.2 Purpose and motivation

The central goal of this thesis is to gain a better understanding of the impact that a customer's knowledge about AI technology has on their openness to interact with products and services that are enabled by AI. Furthermore, the author aims to determine which factors and beliefs could explain the relationship between knowledge about AI and openness to interact with AI-enabled products and services. When speaking about AI-enabled products and services, the author refers to Business-to-Consumer ("B2C") products and services. The increasing impact of AI on different business areas shows the necessity for organizations to understand this relationship. The more customers are required to actively interact with AI-enabled products and services – be it by driving an autonomous car, speaking to their virtual assistant or by receiving a diagnosis from their doctor – the more relevance this topic will gain.

The rest of the study is organized as follows: In chapter two the author analyzes the topic of AI as well as factors that have an influence on customer's openness towards AI, by systematically reviewing existing literature and surveys. In chapter three, the research question is presented, and the conceptual model and hypotheses are developed. The next section clarifies the applied methodology and discusses the method and procedures applied. In chapter five, the findings of the data analysis are presented and further discussed in chapter six. Implications for future research as well as limitations of the study are provided. Conclusions and results are summed up in chapter seven.

2 Literature Review

2.1 The concept of Artificial Intelligence

While AI is a widely discussed topic that has been around for more than 60 years as an official discipline, no consensus definition for AI has been crowned. In a report from Stanford University, coined the "One Hundred Years Study on Artificial Intelligence", the authors state that "Curiously, the lack of a precise, universally accepted definition of AI probably has helped the field to grow, blossom, and advance at an ever-accelerating pace. Practitioners, researchers, and developers of AI are instead guided by a rough sense of direction and an imperative to 'get on with it'" (Stone et al., 2016). One broad, but frequently used definition has been provided by Nilsson (2010): "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment". To narrow this down, Cam, Chui, and Hall (2019) define AI as machines being able to perform cerebral functions that are typically associated with human minds, such as leaning, perceiving, problem-solving, and decision making, as well as performing physical tasks. AI can be divided into several sub-dimensions with the most frequently implemented and researched ones being Machine Learning, Neural Networks, Natural Language Processing, and Computer Vision (Cam, Chui, and Hall, 2019). Each sub-dimension employs different methodologies of data analysis, learning algorithms and results interpretation but aim to perform cognitive functions to find solutions for complex problems. The most significant advances in AI can currently be found in the subdomain machine learning – in combination with deep learning and neural networks – which are based on mathematical algorithms that increase their performance over time when processing larger amounts of data (Edelman, 2019). AI-powered solutions are applied to a large range of problems. Solutions encompass virtual customer service agents, semi-autonomous vehicles, accurate diagnostic tools, and personal drug treatment in healthcare, as well as fraud detection and automatic

portfolio assembling in financial services, amongst others (Adams, 2017; Edelman, 2019; Daley, 2019; Kaminsky, 2019). Future applications include devices that allow humans to converse with machines via natural language, without using any voice and fully autonomous vehicles (Stone et al., 2016; Kapur, Kapur, and Maes, 2018). Within this study, this broad definition of Cam, Chui, and Hall (2019) is used to grasp the sentiment and expectations of customers who do not necessarily have a more concise understanding of AI.

2.2 Knowledge and Technology Acceptance

While the knowledge about specific technologies has so far not been integrated into established technology acceptance models, several surveys show that one's knowledge about Artificial Intelligence may well have an impact on the openness towards using the technology.

Pega (2017) found that while 70% of respondents to their survey stated that they understand AI, nearly 50% were not able to recognize the core of what AI is, such as enabling machines to learn new things, solve problems or understand speech. Additionally, they found that of all respondents, only 35% were comfortable with businesses using AI to interact with them. Interestingly, of respondents who had not interacted with AI before, only 25% were comfortable with this – considering respondents who had interacted with AI before, 55% were comfortable with this AI-enabled interaction (Pega, 2017). Weber Shandwick (2016) found that the most common association with AI is "robots" as mentioned by 22% of respondents. Differentiating between customers who are more or less knowledgeable about AI, the study shows that the top three associations for customers with more knowledge are (1) robots, (2) assistance/helpful, and (3) intelligence/computers that can think. Less knowledgeable customers associate (1) robots, (2) control/machines take over/job loss, and (3) advanced/future/innovation with the term Artificial Intelligence – those associations being linked to fear and uncertainty. The study further shows that significant differences between customers with different levels of knowledge about AI exist, when asking about expectations towards a very/somewhat positive societal and

personal impact of AI. The more knowledgeable group expects significantly more benefits than the less knowledgeable group. Furthermore, the preference of more knowledgeable customers of AI development to accelerate is significantly higher. Such a knowledge gap – with 25% of respondents fearing the rise of robots and the enslavement of humanity – can easily shape customer's perception of AI and therefore their openness to interact with products and services that are enabled by AI (Pega, 2017).

Researchers found that AI-aware customers – those who say that they are aware of having interactions with AI – derive more benefits from interactions that are enabled by AI. Amongst those expected benefits are greater control over interactions, 24/7 availability, and a faster resolution of support issues (Buvat et al., 2018).

2.3 Customer beliefs about Artificial Intelligence

Several studies have been performed to gather customers' perception of AI and their expectations towards organizations that use AI in their products and services. These products and services range across a wide spectrum of applications, including AI in customer service, medical diagnostics, financial services, and semi-autonomous vehicles, amongst others. The factors that seem to shape customer's openness about AI is their belief about the technology in terms of (1) efficiency, (2) convenience, (3) privacy protection, and (4) data security of such solutions. It is important to note that a customer's belief of such factors is highly subjective but seems to shape customer's decision about being open to interacting with the technology or not (Hengstler, Enkel, and Duelli, 2016; Enkel, 2017; Pega, 2017; Buvat et al., 2018; Sabia and Baghdassarian, 2018; Brink, 2019; Edelman, 2019).

Efficiency and Convenience. In their customer experience survey, Clarke and Kinghorn (2018) found that for 80% of respondents efficiency is the most important factor that influences customer experience, closely followed by convenience. Customers are willing to pay more for both efficient and convenient products and services.

Considering ***efficiency***, AI-aware customers reported that faster resolutions of customer support issues and a reduction of effort in their end, are significant benefits of AI-enabled technology in customer service (Buvat et al., 2018). Furthermore, saving time and money are amongst the top reasons why customers would use AI. Efficiency can further be thought of as finding the best deal for a specific purchase and the best route to a specific location (Sabia and Baghdassarian, 2018). Pega (2017) found that 68% of respondents in their survey would be more open to using more AI if it would help them in their everyday life with, for instance, saving money and time. Characteristics that determine ***convenience*** – such as 24/7 availability, easier access to information and answers to both simple and complex questions via AI-enabled products and services – are beliefs of customers when interacting with AI-enabled products and services (Buvat et al., 2018; Sabia and Baghdassarian, 2018). A survey conducted by Weber Shandwick (2016) found that 69% of respondents believe that AI can give them the benefits of accessing relevant news and information more easily. Further, 68% of respondents see the benefit of products and services that provide greater ease and convenience for customers.

Privacy and Data Security. Sabia and Baghdassarian (2018) found that 65% of their respondents believe that AI is rather going to destroy their privacy rather than enhance it. Out of AI-aware customers, a Capgemini study shows that only 30% of respondents expect better privacy and security of their personal data, meaning that 70% of AI-aware customers either do not believe that AI changes privacy and data security or they believe that it worsens those issues (Buvat et al., 2018). Likely, customers that use AI less and are less knowledgeable, have more concerns about privacy and data security issues. Weber Shandwick (2016) found that cyber-attacks or computer hacking and less security of personal data and privacy are amongst the major concerns of customers – 53% and 52% respectively believe are “very concerned” about

those issues, with another 37% and 35% being "somewhat concerned". Additionally, Hengstler, Enkel, and Duelli (2016) found that operational safety and data security are critical factors for customers to trust AI technology.

3 Research Question, Conceptual Model and Hypotheses

3.1 Research Question

This study aims to combine different approaches of previous studies and surveys to build a more comprehensive model that can predict the openness of customers towards AI technology: **(1)** Previous surveys have shown that prior knowledge and previous interactions with AI have a positive influence on customers openness to further interact with products or services that are enabled by AI (Weber Shandwick, 2016; Pega, 2017; Buvat et al., 2018). **(2)** Additionally, different surveys found that customers have beliefs about specific benefits (efficiency and convenience) and risks (data security and privacy protection) when interacting with AI-enabled products and services.

The abovementioned surveys give some reference points about possible relationships between (1) customer's knowledge about AI; (2) customer's perception of efficiency, convenience, privacy protection and data security of AI-enabled products/services and (3) their openness to interact with the respective products and services. Nevertheless, this topic has not yet been studied empirically. The purpose and research question of this study is therefore, to create a first empirical model to close this research gap and **e*xamine whether efficiency, convenience, privacy protection and data security have a mediating effect on the relationship between knowledge about AI and openness towards AI-enabled products and services.***

3.2 Conceptual Model

Figure 1 shows a graphic visualization of the underlying conceptual model, on which this thesis is based upon. A customer's level of knowledge about AI is expected to influence his or her openness to interact with AI-enabled products and services. This relationship is expected to be

partially mediated by the customers' beliefs about efficiency, convenience, privacy protection and data security of AI-enabled products and services. As such, it is assumed that those variables partially explain the relationship between a customer's knowledge about AI and his/her openness towards AI-enabled products and services. Following this logic and the previously presented research, a customer's knowledge about AI is expected to have a direct relationship with his/her openness to interact with AI-enabled products and services. Further, an indirect relationship that is partially explained by his/her beliefs about the efficiency, convenience, privacy protection and data security of AI-enabled products and services, is expected.

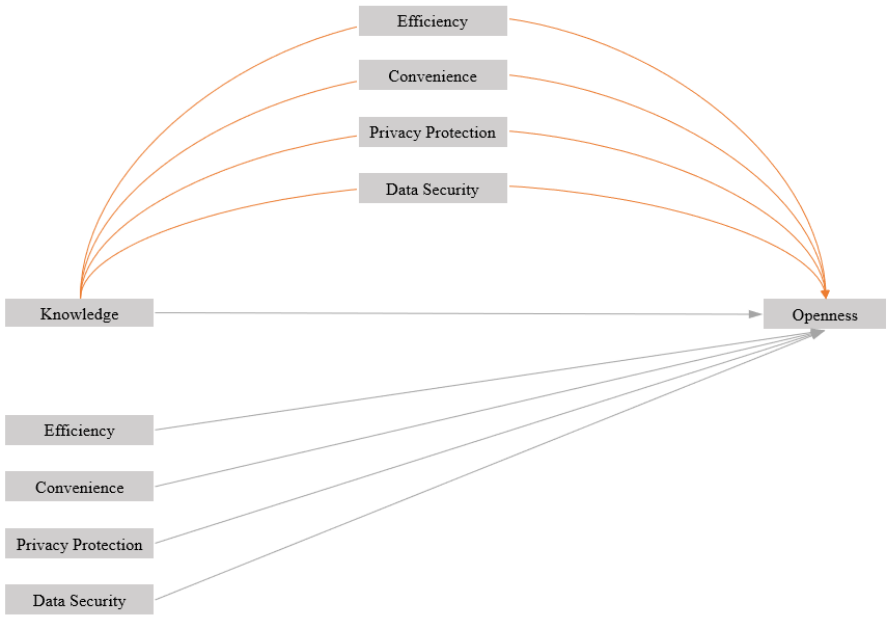

Figure 1: *Conceptual Model*

3.3 Hypotheses

For a mediator effect to be present, several conditions need to be fulfilled. Firstly, a direct relationship between knowledge about AI and openness towards AI needs to be present. Secondly, a relationship between knowledge and the individual mediators needs to be present. Thirdly, a relationship between knowledge, the mediators and openness to AI needs to be

present. Lastly, an indirect effect (mediation effect) needs to be present from knowledge about AI via the mediators towards openness to AI (Shrout and Bolger, 2002; Hayes, 2018).

In a first step, it needs to be confirmed that a direct relationship exists between a customer's knowledge about AI and the respective openness towards AI, as suggested in several surveys (for example Weber Shandwick, 2016; Pega, 2017; Buvat et al., 2018).

H1: There is a positive relationship between a customer's ***knowledge*** *about AI and a customer's* ***openness*** *to use AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

In a second step, several hypotheses about the different mediators were created. It has been shown that customers who are more knowledgeable about AI expect more benefits from this technology (Weber Shandwick, 2016). Furthermore, efficiency and convenience significantly affect customer experience (Clarke and Kinghorn, 2018) and that the two factors are perceived to be benefits when interacting with AI-enabled products and services (Weber Shandwick, 2016; Pega, 2017; Buvat et al., 2018; Sabia and Baghdassarian, 2018). As such, customers who believe that the usage of AI-enabled products and services leads to gains in efficiency, are expected to be more likely to be open to and have the intention to use Artificial Intelligence. Similarly, customers who expect gains in terms of convenience, due to the usage of AI-enabled products and services, are expected to be more likely to be open and have the intention to use Artificial Intelligence.

H2.1: *There is a positive relationship between a customer's* ***knowledge*** *about AI and a customer's belief about the* ***efficiency*** *of AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H2.2: *There is a positive relationship between a customer's belief about the* ***efficiency*** *of AI-enabled products/services and a customer's* ***openness*** *to use AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H2.3: *The relationship between* ***a customer's knowledge*** *about AI and a customer's* ***openness*** *to use AI-enabled products/services is* ***mediated by his/her*** *belief about the* ***efficiency*** *of AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H3.1: *There is a positive relationship between a customer's* ***knowledge*** *about AI and his/her belief about the* ***convenience*** *of AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H3.2: *There is a positive relationship between a customer's belief about the* ***convenience*** *of AI-enabled products/services and a customer's* ***openness*** *to use AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H3.3: *The relationship between **a customer's knowledge** about AI and a customer's **openness** to use AI-enabled products/services is **mediated by** his/her belief about the **convenience** of AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

Several studies indicated that customers are worried about a loss of privacy due to AI technologies that listen to their conversations or track their every step. Additionally, customers believe that their private data are not secured well enough – data security has frequently been determined to be a risk. (Hengstler, Enkel, and Duelli, 2016; Weber Shandwick, 2016; Buvat et al., 2018; Sabia and Baghdassarian, 2018). In the case that customers believe that privacy protection and data security standards of AI-enabled products and services are high and customers do not fear the loss of privacy and data security more than with other products and services, openness to AI is expected to be high.

H4.1: *There is a positive relationship between a customer's **knowledge** about AI and his/her belief about **privacy protection** when using AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H4.2 *There is a positive relationship between a customer's belief about his/her **privacy protection** when using AI-enabled products/services and a customer's **openness** to use AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H4.3: *The relationship between **a customer's knowledge** about AI and a customer's **openness** to use AI-enabled products/services is mediated by his/her belief about **privacy protection** when using AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H5.1: *There is a positive relationship between a customer's **knowledge** about AI and a customer's belief about the **data security** of AI-enabled products/services.* H_0: $\beta = 0$, H_1: $\beta > 0$

H5.2*: There is a positive relationship between a customer's belief about the **data security** of AI-enabled products/services and a customer's **openness** to use AI-enabled products/services.*
H_0: $\beta = 0$, H_1: $\beta > 0$

H5.3: *The relationship between a **customer's knowledge** about AI and a customer's **openness** to use AI-enabled products/services is **mediated by his/her** belief about the **data security** of AI-enabled products/services* H_0: $\beta = 0$, H_1: $\beta > 0$

4 Method

4.1 Participants and Procedures

To test the conceptual model and the concomitant hypotheses, a quantitative survey was conducted. The survey was performed using the SAP Qualtrics tool and distributed via social media and the author's private network by sharing the survey link, according to the snowball method (Oregon State University, 2019). After a period of two weeks, 434 responses were

collected. Due to incompletion, 95 responses were excluded. To avoid a bias due to cultural differences, as suggested by Hofstede (2003), the most diverging cultures were excluded from the analysis. Those nationalities include one respondent from Sri Lanka, one respondent from Kazakhstan as well as six respondents from China, Singapore, and India. This leaves the final sample with a sample size of N = 331. The demographics of survey participants are represented in Table 4, with 49.5% of participants being female and 50.5% of participants being male. The average age of survey participants is 37.9 years (SD = 15.9), ranging from 16 to 85 years. Furthermore, nationality was coded as a dummy variable, representing respondents with a Germanic background (Germany, Austria, and Switzerland) and respondents with a different cultural background. 81.6% of survey participants have a Germanic background, and 18.4% have a different cultural background. Lastly, a dummy variable was coded for respondents with and without a background in Science, Technology, Engineering and Mathematics ("STEM") – 41.7% of respondents having a STEM background and 58.3% of respondents having a non-STEM background.

4.2 Measures and Reliability Measures

To test the reliability of the different variables which consist of several questions, Cronbach's Alpha was calculated as a measure of reliability and internal consistency of the respective variables (Gliem and Gliem, 2003; Tavakol and Dennick, 2011). Cronbach's alpha is measured on a scale from 0-1 with alpha's > 0.7 being considered as very reliable and alpha's < 0.5 being unacceptable (Goforth, 2015).

To measure the dependent variable - a ***customer's openness to interact with AI-enabled products and services*** -, a construct of four questions was formed and tested – the respective questions can be found in Table 1. All questions were developed with five-point Likert scales, ranging from (1) "Strongly Disagree" to (5) "Strongly Agree", with the latter referring to a customer being open to interacting with AI-enabled products and services. With a Cronbach's

Alpha of $\alpha_{Openness} = 0.887$, representing a reliable scale. To measure the independent variable ***knowledge about AI***, data on several factors were gathered, that are related to and drive knowledge about AI. More specifically, the construct is comprised of three factors: (1) a self-assessment about the respondents' knowledge about AI, measured on a five-point Likert scale *(from 5 = "I have a lot of knowledge about AI" to 1 = "I have no knowledge about AI")*, (2) if the respondent believes that he/she has interacted with AI in the past 30 days and if he really has interacted with AI and (3) how many attributes of AI, the respondent can correctly match with AI. Table 3 shows the methodology after which this variable was computed. Since this variable is based on a score and not on a consistent scale, Cronbach's Alpha must not be calculated.

To measure the independent and control variables - a customer's belief about the efficiency and convenience when interacting with AI-enabled products and services, as well as a customer's belief about his/her privacy protection and data security when interacting with AI-enabled products and services -, four different constructs out of several questions were created and can be found in Table 1. To asses a customer's ***efficiency*** beliefs, four items form a construct with Likert Scales ranging from (1) "Strongly Disagree" to (5) "Strongly Agree", yielding an $\alpha_{Efficiency} = 0.759$. A customer's beliefs about ***convenience*** when interacting with AI-enabled products and services, are similarly measured on a Likert Scale ranging from (1) "Strongly Disagree" to (5) "Strongly Agree". This construct consists of three items and has an $\alpha_{Convenience} = 0.518$, which is rather weak. A customer's belief about ***privacy protection*** when interacting with AI-enabled products and services, consists of three items that are measured on a reversed Likert Scale, meaning that (1) "Strongly agree" refers to privacy concerns and (5) "Strongly Disagree" refers to the belief that privacy is well-protected. The Cronbach's Alpha of this cluster amounts to $\alpha_{Privacy\ Protection} = 0.767$. Lastly, a customer's belief about ***data security*** when interacting with AI-enabled products and services was tested.

Like privacy protection, two of the three items were measured on a revered Likert Scale with (1) “Strongly Agree” referring to data security concern and (5) “Strongly Disagree” referring to well-established data security measures. The last item of this construct was measured on a normal Likert Scale with (1) “Strongly Disagree” referring to data security concerns and (5) “Strongly Agree” referring to well-established data security measures. Data security yields a Cronbach’s Alpha of $\alpha_{Data\ Security} = 0.739$, which represents a reliable construct.

Despite the hypothesized mediation model and the effects of knowledge about AI and customer’s beliefs about the efficiency, convenience, privacy protection and data security of AI-enabled products and services within this model, the openness towards AI-enabled products and services may be affected by additional variables (Hayes, 2018). To account for these alternative variances, control variables are used. The control variables are (1) gender, (2) age, (3) nationality and (4) STEM background. Gender, nationality, and STEM-background were coded as dummy variables.

4.3 Models and Estimation Methods

4.3.1 Models

Model 1 and 2 represent the two base models which need to hold, such that testing the mediator model 3 is plausible. Model 1 establishes the relationship between a customer’s knowledge about AI and his/her openness to interact with AI-enabled products and services.

(1) $\text{Openness}_i = \beta_0 + \beta_{Age} + \beta_{Gender} + \beta_{Nationality} + \beta_{STEM} + \beta_{Knowledge} + \varepsilon_i$

Openness is the dependent variable and denotes a customer’s openness to interact with AI-enabled products and services. ***Age*** is a control variable that denotes the customer’s age, ***Gender*** is a control variable that takes the value of 1 for female and the value of 0 for male, ***Nationality*** is a control variable that takes the value of 1 for a Germanic Culture and 0 for a non-Germanic culture and ***STEM*** is a control variable that takes the value of 1 for a customer with a STEM background and 0 for one with a non-STEM background. ***Knowledge*** is the independent

variable that measures a customer's knowledge about AI. The constant is denounced by β_0 and ε_i represents the error term.

Secondly, Model 2 establishes the relationship between a customer's knowledge about AI and his/her belief about the efficiency, convenience, privacy protection and data security when interacting with AI-enabled products and services. The dependent variables of Model 2 are ***Efficiency*** in Model (2.1), ***Convenience*** in Model (2.2), ***Privacy Protection*** in Model (2.3), and ***Data Security*** in Model (2.4).

(2.1) $Efficiency_i = \beta_0 + \beta_{Age} + \beta_{Gender} + \beta_{Nationality} + \beta_{STEM} + \beta_{Knowledge} + \varepsilon_i$

(2.2) $Convenience_i = \beta_0 + \beta_{Age} + \beta_{Gender} + \beta_{Nationality} + \beta_{STEM} + \beta_{Knowledge} + \varepsilon_i$

(2.3) $Privacy\ Prot_i = \beta_0 + \beta_{Age} + \beta_{Gender} + \beta_{Nationality} + \beta_{STEM} + \beta_{Knowledge} + \varepsilon_i$

(2.4) $Data\ Sec_i = \beta_0 + \beta_{Age} + \beta_{Gender} + \beta_{Nationality} + \beta_{STEM} + \beta_{Knowledge} + \varepsilon_i$

Lastly, Model 3 establishes the relationship between knowledge about AI, efficiency, convenience, privacy protection and data security as independent variables with openness to AI as the dependent variable.

(3) $Openness_i = \beta_0 + \beta_{Age} + \beta_{Gender} + \beta_{Nationality} + \beta_{STEM} + \beta_{\text{Efficiency}} + \beta_{Convenience} + \beta_{Privacy\ Protection} + \beta_{Data\ Security} + \beta_{Knowledge} + \varepsilon_i$

Model 3 measures (a) the direct effect of ***Efficiency, Privacy Protection, Convenience*** and ***Data Security*** on ***Openness***, (b) the indirect effect that goes from ***Knowledge*** via the mediators to ***Openness*** and (c) the direct effect of ***Knowledge*** on ***Openness*** Figures 2-4 show the statistical models which are tested.

4.3.2 Estimation Method

To calculate both the direct and indirect effects, and to determine if the effects are significant, the bootstrapping method is used as suggested by several authors (Bollen and Stinet, 1990; Shrout and Bolger, 2002; MacKinnon, Lockwood, and Williams, 2004; Williams and MacKinnon, 2008). Bootstrapping is a non-parametric method based on re-sampling with

replacement. Repeating this process 5000 times as in the applied estimation model allows for calculating the indirect effects of each of the samples and as such a sampling distribution can be calculated. The resulting distribution allows for defining a confidence interval to test for significance of the indirect effect – if zero is not within the determined confidence interval, the indirect effect is non-zero with the % confidence of the confidence interval (Hayes, 2009). The mediation analysis was performed with the Process Macro V3.4 in SPSS, which was developed by Andrew F. Hayes, using 5000 bootstrap samples (2018).

5 Results

5.1 Descriptive Statistics

Standard deviations and correlations for all relevant variables can be found in Table 4. The average knowledge about AI is 5.75 (SD = 1.69) – a minimum of 1 point and a maximum of 9 points could be achieved here. Looking at the self-assessment of the survey participants (M = 3.34; SD = 0.87), four respondents indicated that they have no knowledge about AI, 53 respondents stated that they have heard about AI but do not know much about it, 123 respondents stated that they have little knowledge about AI and 128 and 23 respondents stated that they have some basic or a lot of knowledge about AI, respectively. The mean of correctly identified AI capabilities is 1.97 (SD = 0.87), meaning that on average, the respondents were able to correctly identify 4 of 6 AI-related capabilities, as each correctly identified capability amounts to 0.5 points. Only 43.5 % of respondents correctly stated that they have interacted with AI in the previous 30 days and have also given an example of at least one AI-enabled product or service they interacted within this timeframe. This indicates that many respondents have either interacted with AI-enabled devices but did not realize it or believe that they have interacted with AI-enabled products and services but could not give an example. This lack in knowledge of some survey participants should not have a negative effect on the results, as definitions and examples of AI were only given after those questions were asked, to get an

unbiased result of a customer's actual knowledge about AI. To ensure that every survey participant has a fair understanding of AI in the broadest sense, a definition and several examples were given to survey participants (see Appendix 1). The mean of openness is 3.9 (SD = 0.73), depicting that on average respondents are quite open to interacting with AI-enabled products and services, as openness is measured on a scale from (1) "Strongly Disagree" to (5) "Strongly Agree". The means of the different beliefs about AI-enabled products and services, differ significantly from privacy protection with M = 2.3 (SD = 0.86) to data security with M = 3.0 (SD = 0.45), convenience with M = 3.87 (SD = 0.68) and efficiency with M = 3.95 (SD = 0.61). This indicates that while on average respondent's belief that AI-enabled products and services are more efficient and convenient than other products and services, they believe that their privacy is less protected when interacting with AI-enabled products/services. Looking at data security, respondents do not believe that there is a difference between interacting with products and services that are AI-enabled or not AI-enabled.

5.2 Inferential Statistics and Hypothesis Testing

The results of ***Models 1-3*** can be found in Tables 5-10. ***Model 1*** shows that knowledge is indeed a significant variable for explaining a customer's openness to interact with AI-enabled products and services – the model is significant ($p < 0.01$) and with $R^2 = 22.2\%$ meaning that knowledge and the control variables explain 22.2% of the variation in openness. Furthermore, with a standardized $\beta_{Knowledge} = 0.383$ ($\triangleq$ a in Figure 2; $p < 0.01$) it can be shown that with each increase of one standard deviation in a respondents knowledge about AI, the openness towards using AI-enabled products and services increases by 0.383 standard deviations. Furthermore, age is significant ($p = 0.004$) but openness only increases by 0.007 for each additional year of age ($\beta_{Age} = 0.007$, standardized $\beta_{Age} = 0.154$). *This result supports the underlying hypothesis H.1, showing a significantly positive relationship between knowledge about AI and openness towards AI.* ***Model 2.1-2.4*** measure the direct effects of knowledge on the four mediator

variables. ***Model 2.1*** shows that knowledge about AI has a significant effect on a customer's belief about the efficiency of AI-enabled products and services. The relationship is positive with a standardized $\beta_{Knowledge} = 0.294$ (≙ b in Figure 3; $p < 0.01$), meaning that for each increase of one standard deviation in knowledge about AI, a customer's belief in the efficiency of AI increases by 0.294 standard deviations. ***Model 2.2*** shows that knowledge also has a significant impact on a customer's beliefs about convenience. With each increase of one standard deviation in knowledge about AI, a customer's belief in the convenience of AI increases by 0.3 standard deviations (Standardized $\beta_{Knowledge} = 0.3$ ≙ c in Figure 3; $p < 0.01$). ***Model 2.3*** analyses the relationship between knowledge and privacy protection, with knowledge being a significant predictor – for each increase of one standard deviation in knowledge about AI, a customer's belief in the privacy protection of AI increases by 0.136 standard deviations (Standardized $\beta_{Knowledge} = 0.136$ ≙ d in Figure 3; $p = 0.023$). Within this model, nationality is a significant control variable showing that respondents of the Germanic cultures expect a better privacy protection of AI-enabled products and services than respondents with other cultural backgrounds ($\beta_{Nationality} = 0.466$; standardized $\beta_{Nationality} = 0.211$; $p < 0.01$). ***Model 2.4*** analyses the relationship between knowledge about AI and data security. This model is rather weak and insignificant with an $R^2 = 1.5\%$ and an overall p-value of $p = 0.427$, compared to Model 2.1-2.3 which are all significant at $p < 0.01$. The model depicts that there is a positive relationship between knowledge about AI and a customer's belief about the data security of AI-enabled products and services, but that it is not significant ($\beta_{Knowledge} = 0.028$; standardized $\beta_{Knowledge} = 0.107$ ≙ e in Figure 3; $p = 0.079$). *This result supports the underlying hypotheses H2.1, H3.1 and H4.1, showing a significantly positive relationship between knowledge about AI and respondents' belief in efficiency, convenience, and privacy protection. Hypothesis H5.1 is not supported – the relationship between knowledge and data security is not significant.*

Model 3 tests the direct effect of knowledge, efficiency, convenience, privacy protection and data security on openness and the indirect effects that the hypothesized mediator variables have on the relationship between knowledge and openness. The model is significant with a p-value of $p < 0.01$ and with an $R^2 = 56.1\%$ explains a large part of the variation in openness towards AI-enabled products and services.

Compared to ***Model 1,*** in which the direct standardized effect of knowledge on openness was $\beta_{Knowledge} = 0.383$, the direct standardized effect of knowledge on AI within ***Model 3*** has decreased to $\beta_{Knowledge} = 0.172$ (≙ a' in Figure 4 ; $p < 0.01$). The rest of the initial effect from ***Model 1*** is explained by the mediators via indirect effects which amount to a total indirect effect of 0.211. The significance of the indirect effects has been determined via the bootstrapping of 5000 samples and apart from data security are significant as the $\alpha = 1\%$ Confidence Interval is non-zero. The indirect effects itself can be determined by multiplying the standardized direct effect of, e.g. knowledge on efficiency ($\beta_{Knowledge}$ in Model 2.1) with the standardized direct effect of efficiency of on openness ($\beta_{Efficiency}$in Model 3).

Efficiency mediates the relationship of knowledge with openness through an indirect effect of $\beta_{Efficiency} = 0.137$ (≙ j in Figure 4; $p < 0.01$). Convenience and privacy protection also mediate the relationship of knowledge and openness through indirect effects of $\beta_{Convenience} = 0.047$ (≙ k in Figure 4; $p < 0.01$) and $\beta_{Privacy\ Protection} = 0.026$ (≙ l in Figure 4; $p < 0.01$). Data Security is insignificant and does not mediate the effect between knowledge and openness. Additionally, a customer's belief about the efficiency, convenience and privacy protection of AI-enabled products and services, have positive and significant relationships with openness. For each increase of one standard deviation in efficiency, a customer's openness to AI increases by 0.466 standard deviations (standardized $\beta_{Efficiency} = 0.466$ ≙ f in Figure 4; $p < 0.01$). Convenience and privacy protection also have significant positive relationships with openness (standardized $\beta_{Convenience} = 0.155$ ≙ g in Figure 4; $p = 0.001$ and standardized

$\beta_{Privacy\ Protection} = 0.193 \triangleq$ h in Figure 4; $p < 0.01$). For each increase in one standard deviation of convenience and privacy protection, a customer's openness towards AI-enabled products and services increases by 0.155 and 0.193 standard deviations, respectively. Data security has a positive, but insignificant relationship with openness (standardized $\beta_{Data\ Securtiy} = 0.009 \triangleq$ i in Figure 4; $p = 0.82$). *This result supports the underlying hypotheses H1, H2.2, H3.2 and H4.2, showing a significantly positive relationship between knowledge, efficiency, convenience, and privacy protection with openness towards AI. Hypothesis H5.2 is not supported – while a positive relationship between data security with openness exists, this relationship is not significant. Furthermore, the mediation hypotheses H2.3, H3.3 and H4.3 are supported while the mediation hypothesis H5.3 is not supported.*

6 Discussion

6.1 Discussion of Results

The analysis shows several interesting insights about customer's openness to interact with AI-enabled products and services. Firstly, it becomes evident that customer's knowledge about AI technology is of high importance to explain their openness towards interacting with AI-enabled products and services – customers who are more knowledgeable about AI, are also more open to using AI-enabled products and services. The results match the expectation that the more customers know about Artificial Intelligence, the more open they are to interact with products that are based on AI technologies. Furthermore, the analysis shows that customers have specific beliefs about differences in the efficiency, convenience, privacy protection and data security of AI-enabled products and services compared with "normal" products and services. Considering the factors of efficiency and convenience, customers believe that AI-enabled products and services are more efficient and convenient to use, compared with other products and services. Furthermore, customers who believe very strongly that AI-enabled products and services are very efficient and convenient, are also more open to using such AI-enabled products and

services. Considering privacy protection, customers generally believe that this factor is worse within AI-enabled products and services. Nevertheless, customers who have a more positive belief about the privacy protection of AI-enabled products and services are also more open to use those. Interestingly, customers do not see a difference between the data security of AI-enabled and non-AI-enabled products and services.

Another interesting finding of this study is the relationship of customers knowledge about Artificial Intelligence and the customers' respective beliefs with respect to the efficiency, convenience, privacy protection and data security of AI-enabled products and services. The study shows that customers with more knowledge about AI have significantly more positive beliefs about the efficiency and convenience of AI-enabled products and services meaning that more educated customers have a more positive attitude towards such products and services. Furthermore, more knowledgeable customers also have fewer concerns about their privacy protection when interacting with AI-enabled products and services. While this does not mean that customers care less about their privacy being protected, the results show that more knowledgeable customers are less worried about their privacy when interacting with products and services that are or are not enabled by AI. Considering data security, the insignificant relationship between knowledge about AI and data security shows that customers are neither more or less concerned about data security when interacting with AI-enabled products and services. Lastly, the study also shows that the relationship between customers knowledge about AI and their openness to interact with AI-enabled products and services is partially mediated by customers' beliefs about those AI-enabled products and services in terms of efficiency, convenience, and privacy protection while data security is not relevant.

6.2 Recommendations for Practice

The combined findings of this study contain several important implications for managers when aiming to develop products and services that are enabled by Artificial Intelligence. Firstly,

customers knowledge about AI has both a direct relationship with their openness to using AI-enabled products and services, as well as a direct relationship with their beliefs about benefits and risks of such products and services.

Developing new products and services for their consumers, it is companies' primary goal to sell their products and as such to ensure that customers want to use their products. For their customers to have an intention to use and buy the products and services they offer, companies are required to ensure that their customers are open to the products and services they offer. Specifically, when employing new technologies in their products and service, openness to such technologies is a key driver for customers intention to use such products as has been shown in several studies (Pega, 2017; Buvat et al., 2018). Following this logic, the present study shows that customers openness to use AI-enabled products and services is significantly influenced by their knowledge about AI and furthermore, more knowledgeable customers associate more positive benefits with AI and AI-enabled products and services. As such, companies are urged to create knowledge about AI in their customer base to create openness towards their products and services and as such being able to sell the respective products and services. It is important to note the difference between advertising/marketing and customer education. Marketing often attempts to persuade customers on an emotional level to only see the beneficial features and advantages of a product. Contrary, customer education aims at providing the customer with all relevant information about the product and its functionalities such that the customer understands how to use the product to solve a problem (Eisingerich and Bell, 2008; Bell, Auh, and Eisingerich, 2017). Customer education leads to increased brand loyalty and trust, especially in a time during which companies try to market only benefits of their products instead of enhancing its customers knowledge about the nature of their products and services and equipping them with the best skills to use them (Craig, 2015; Okeke, 2017). In combination with the findings of this study, the question remains how to educate customers about Artificial

Intelligence to in turn increase their openness and intention to use AI-enabled products and services.

Depending on the nature of the product or service, there are different approaches companies can take. Considering physical products that are enabled by AI – ranging from voice assistants like Alexa to autonomous vacuum cleaners or autonomous cars – companies can create hands on experience within their stores. This includes allowing customers to watch, touch and experience those products by either trying them out themselves or being shown how the product works and can solve their problems (Okeke, 2017; Nicod, Llosa, and Bowen, 2020). For other types of AI-enabled products and services – other types of customer education must be employed. Consider a customer who is soon going to have a meeting with his financial advisor to speak about the performance of their financial portfolio (e.g. Mejia, 2020) . If the financial institution aims to hold such meetings through AI-enabled (non-human) virtual financial advisors in the future, it may be recommendable to start educating customers about such AI-enabled financial advisors during a meeting with the personal financial advisor. This means that during a meeting with the customer and his personal financial advisor, a virtual AI-enabled advisor joins the meeting to make the customer more comfortable and open for future interactions with an AI-enabled virtual financial advisor (Adkisson, 2019; Fantato, 2019). In addition to this specific product-related or service-related customer education, companies can also educate their customers about Artificial Intelligence, in general. This could be achieved by for example a social media campaign that aims to bring the meaning of AI closer to its customers or by organizing events together with leading research institutes about AI.

While customers knowledge about AI has a positive relationship with heir openness to use AI-enabled products and services, a part of this relationship can be explained by customers perceived benefits and risks – efficiency, convenience, privacy protection and data security – of AI-enabled products and services. Further, a direct relationship exists between the perceived

benefits and customers openness to interact with AI-enabled products and services. This allows for the second recommendation towards managers – being more user-centric when developing new products and services. User centricity ensures that customers acknowledge that using the offered AI-enabled products and services makes their life more efficient and more convenient. Furthermore, companies need to ensure that customers trust their products and services in terms of privacy protection and data security. While a part of this can be achieved by educating the customer about the respective products and services, additional measures can be taken. Companies can achieve a customer-centric product or service development by employing an iterative hypothesis-based process of prototyping products and testing those prototypes against relevant KPIs of evidence-based management approaches. Such testing should include existing as well as potential customers (Sauvola et al., 2015; Palmatier et al., 2019; Simpson Rochwerger, 2020). Therefore, while companies should increasingly educate their customers about AI, companies should also focus on the efficiency and convenience that those products and services bring into the lives of their customers and ensure that high standards of privacy protection and data security are implemented and publicly communicated.

6.3 Limitations and Suggestions for Future Research

Within this study, the reliability of the construct that measures customers beliefs about the convenience of AI-enabled products and services is questionable. With a Cronbach's Alpha of $\alpha_{Convenience} = 0.518$, it is close to falling under the acceptable threshold of 0.5. Nevertheless, convenience itself is a construct that measures a variety of different features that products and services could have. For future studies, the author recommends analyzing if different features should be weighted differently to form a reliable construct. This could mean that for example, easier access to information could receive more weight in the analysis than the 24/7 availability of such products or vice versa. Furthermore, Artificial Intelligence and products/services that are enabled by Artificial Intelligence, have been held very broadly in this study. Due to the

lack of empirical studies on this subject, this was necessary to close this research gap, in a first step. For future research, the author recommends differentiating between different kinds of AI-enabled products and services. This differentiation could be achieved by looking at products/services from a specific industry or by looking at high/low consideration products and services. High consideration products/services are defined as being either expensive and/or having a high emotional value for the customer, while low consideration products/services are either cheap and/or have a low emotional value for customers. Differentiating between such product categories allows to further analyze which factors shape the openness of customers.

7 Conclusion

Considering its potential economic and societal impact, Artificial Intelligence has the capability of being a game-changing technology within the 21st century. The objective of this study was twofold: Firstly, the author aimed at offering a better understanding of the effect that knowledge about AI has on openness towards AI, and to analyze if this relationship can be partially explained by customers beliefs about the efficiency, convenience, privacy protection and data security of AI-enabled products and services. Further, the author aimed to analyze the direct impact that the belief of the respective product and service characteristics has on customers openness towards AI-enabled products and services. Except for data security, all hypothesized relationships were confirmed, allowing for the conclusion that educating one's customers about Artificial Intelligence is of utmost importance for them to develop a more open relationship with AI and offerings that employ this technology. This does explicitly not mean that society should frivolously be educated about the benefits of AI – but a well-balanced knowledge about AI technology and its capabilities should be developed. For commercial AI-enabled products and services, companies can increase their customers' openness to such by educating them about the technology and improving product and service characteristics in terms of for example efficiency, convenience, and privacy protection.

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9 Tables

Table 1: Measurement Scales and Reliability of Constructs

Knowledge

- ❖ Which statement describes your knowledge about Artificial Intelligence, best?
- ❖ Which of the following can Artificial Intelligence currently do? (Check all that apply)
- ❖ Have you interacted with Artificial Intelligence Technology in the past 30 days?
- ❖ Which of the following technologies have you interacted with, in the past 30 days? (Check all that apply)

Openness

- ❖ I am open to use products/services that use AI technology in my everyday life.
- ❖ I intend to use products/services that use AI in my everyday life.
- ❖ I intend to use products/services that use AI, regularly.
- ❖ I am looking forward to interacting with more products/services that are powered by AI.

Efficiency

- ❖ I believe that AI powered products/services make my everyday life more efficient by eg. helping me to find the best route to any destination.
- ❖ AI powered products/services help me to spend less time waiting.
- ❖ AI driven products/services help me to save time.
- ❖ I believe that AI driven products/services help me to get the best deals for my purchases.

Convenience

- ❖ I expect to receive more personalized recommendations via products/services that use AI.
- ❖ I believe that AI driven products/services can give me answers to complex questions.
- ❖ AI enabled products/services give me easier access to information.

Privacy Protection

- ❖ I am concerned about my privacy, when using AI-driven products/services.
- ❖ By using AI driven products/services I feel like companies know everything about me and "listen" all the time.
- ❖ The more companies use AI in their products/services, the less privacy I have.

Data Security

- ❖ My data are protected less if I use products/services that employ AI.
- ❖ I believe that my data are protected less if companies deploy AI in their products/services.
- ❖ AI driven products/services can protect my data well.

Table 2: Tests of reliability - Cronbach's Alpha

Scale

Scale	Cronbach's Alpha	No. of items
Efficiency	.759	4
Convenience	.518	3
Privacy Protection	.767	3
Data Security	.739	3

Scale	Cronbach's Alpha	No. of items
Openness	.887	4

Table 3: Measures of knowledge

	Question	Answers and Scoring
Q3	Which statement describes your knowledge about Artificial Intelligence, best?	I have… …a lot of knowledge = 5 …some basic knowledge = 4 … little knowledge = 3 … heard about it, but do not know much = 2 …no knowledge = 1 about AI
Q4	Which of the following can Artificial Intelligence **currently** do? (Check all that apply)	Per correct = 0.5
Q5	Have you interacted with Artificial Intelligence Technology in the past 30 days?	Yes = 1 / No = 1
Q6	Which of the following have you interacted with, in the past 30 days? (Check all that apply)	Yes & ticked at least one = 1 Yes & ticked none = 0 No & ticked at least one = 0 No & ticked none = 1

Table 4: Descriptive Statistics and Correlation Table

			Pearson Correlation									
	Mean	***SD***	***Know-ledge***	***Efficien-cy***	***Conven-ience***	***Privacy Protection***	***Data Security***	***Open-ness***	***Age***	***Female***	***STEM***	***Nationality***
Knowledge	5.746	1.69	**1**									
Efficiency	3.952	.609	.285**	**1**								
Convenience	3.865	.681	.262**	.542**	**1**							
Privacy Protection	2.344	.857	.097	.168**	-.002	**1**						
Data Security	3.005	.446	.110*	.174**	.136*	.411**	**1**					
Openness	3.921	.733	.405**	.662**	.490**	.287**	.218**	**1**				
Age	37.9	15.9	-.212**	.068	.183**	.069	-.011	.089	**1**			
Female	.495	.501	-.265**	-.135*	-.135*	-.046	-.052	-.252**	-.232**	**1**		
STEM	.417	.494	.227**	.097	.099	.027	.008	.211**	.044	-.250**	**1**	
Nationality	.816	.388	-.129*	-.127*	-.194*	.198**	-.053	-.150**	.081	.081	-.120*	**1**

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 5: Model 1 – Openness (Dependent); Knowledge (Independent); Age, STEM, Gender, Nationality (Covariate)

DV: Openness	**Model 1**					
	Unstandardized Coefficients		Standardized Coefficients			
	B	**SE**	**Beta**	**p**	**LLCI**	**ULCI**
Constant	2.855	.219		.000	2.424	3.285
Age	.007	.002	.154	.004	.002	.012
STEM	-.126	.079	-.086	.114	-.282	.030
Gender	.125	.076	.084	.103	-.025	.275
Nationality	-.181	.094	-.096	.055	-.366	.004
Knowledge	.166	.023	.383[a]	.000	.120	.212
R^2	F (5,325) = 18.588; p < .01; R^2 = .222					
Adjusted R^2	Adj. R^2 = .210					

Table 6: Model 2.1 – Efficiency (Dependent); Knowledge (Independent); Age, STEM, Gender, Nationality (Covariate)

DV: Efficiency	**Model 2.1**					
	Unstandardized Coefficients		Standardized Coefficients			
	B	**SE**	**Beta**	**p**	**LLCI**	**ULCI**
Constant	3.276	0.195		0.000	2.893	3.659
Age	0.005	0.002	0.135	0.018	0.001	0.009
STEM	-0.019	0.071	-0.015	0.791	-0.158	0.120
Gender	0.011	0.068	0.009	0.870	-0.123	0.145
Nationality	-0.154	0.084	-0.098	0.067	-0.318	0.011
Knowledge	0.106	0.021	0.294[b]	0.000	0.065	0.147
R^2	F (5,325) = 7.902; p < .01; R^2 = .108					
Adjusted R^2	Adj. R^2 = 0.95					

Table 7: Model 2.2 – Convenience (Dependent); Knowledge (Independent); Age, STEM, Gender, Nationality (Covariate)

DV: Convenience	**Model 2.2**					
	Unstandardized Coefficients		Standardized Coefficients			
	B	**SE**	**Beta**	**p**	**LLCI**	**ULCI**
Constant	2.977	0.211		0.000	2.562	3.393
Age	0.011	0.002	0.265	0.000	0.007	0.016
STEM	0.029	0.077	0.021	0.709	-0.122	0.180
Gender	0.004	0.074	0.003	0.958	-0.142	0.149
Nationality	-0.312	0.091	-0.178	0.001	-0.490	-0.133
Knowledge	0.121	0.023	0.300[d]	0.000	0.076	0.166
R^2	F (5,325) = 12.27; p < .01; R^2 = .159					
Adjusted R^2	Adj. R^2 = 0.146					

Table 8: Model 2.3 – Privacy (Dependent); Knowledge (Independent); Age, STEM, Gender, Nationality (Covariate)

DV: Privacy Protection	**Model 2.3**					
	Unstandardized Coefficients		Standardized Coefficients			
	B	**SE**	**Beta**	**p**	**LLCI**	**ULCI**
Constant	1.398	0.281		0.000	0.845	1.950
Age	0.004	0.003	0.079	0.173	-0.002	0.010
STEM	-0.007	0.102	-0.004	0.945	-0.208	0.194
Gender	0.029	0.098	0.017	0.765	-0.164	0.223
Nationality	0.466	0.121	0.211	0.000	0.229	0.703
Knowledge	0.069	0.030	0.136[c]	0.023	0.010	0.128
R^2	F (5,325) = 4.221; p < .01; R^2 = .061					
Adjusted R^2	Adj. R^2 = 0.047					

Table 9: Model 2.4 – Data Security (Dependent); Knowledge (Independent); Age, STEM, Gender, Nationality (Covariate)

DV: Data Security	**Model 2.4**					
	Unstandardized Coefficients		Standardized Coefficients			
	B	**SE**	**Beta**	**p**	**LLCI**	**ULCI**
Constant	2.892	0.150		0.000	2.597	3.186
Age	0.000	0.002	0.011	0.860	-0.003	0.004
STEM	-0.022	0.054	-0.025	0.689	-0.129	0.085
Gender	-0.025	0.052	-0.028	0.635	-0.128	0.078
Nationality	-0.048	0.064	-0.041	0.460	-0.174	0.079
Knowledge	0.028	0.016	0.107[e]	0.079	-0.003	0.060
R^2	F (5,325) = .985; p = .427; R^2 = .015					
Adjusted R^2	Adj. R^2 = 0.000					

Table 10: Model 3 – Openness (Dependent); Efficiency, Privacy, Convenience, Data Security, Knowledge (Independent); Age, STEM, Gender, Nationality (Covariate)

DV: Openness	**Model 3**						Standardized Indirect Effects **Knowledge -> Openness**
	Unstandardized Coefficients		Standardized Coefficients				
	B	**SE**	**Beta**	**p**	**LLCI**	**ULCI**	**Beta**
Constant	0.245	0.283		0.388	-0.312	0.803	
Age	0.002	0.002	0.034	0.408	-0.002	0.005	
STEM	-0.119	0.060	-0.081	0.050	-0.237	0.000	
Gender	0.114	0.058	0.077	0.050	0.000	0.228	
Nationality	-0.119	0.074	-0.063	0.112	-0.265	0.028	
Efficiency	0.561	0.055	0.466[f]	0.000	0.453	0.669	0.137[j]
Convenience	0.167	0.050	0.155[g]	0.001	0.068	0.265	0.047[k]
Privacy Protection	0.165	0.037	0.193[h]	0.000	0.093	0.237	0.026[l]
Data Security	0.016	0.068	0.009[i]	0.820	-0.119	0.150	0.001[m]
Knowledge	0.075	0.019	0.172[a']	0.000	0.038	0.112	
R^2	F (5,325) = 45.53; p < .01; R^2 = .561						
Adjusted R^2	Adj. R^2 = .548						

Table 11: Results of hypothesis testing

	Hypothesis 1: *Knowledge and Openness*	**Supported**
H1	There is a positive relationship between a customer's **knowledge** about AI and a customer's **openness** to use AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
	Hypothesis 2: *Efficiency*	**Supported**
H2.1	There is a positive relationship between a customer's belief about the **efficiency** of AI-enabled products/services and a customer's **openness** to use AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
H2.2	There is a positive relationship between a customer's **knowledge** about AI and a customer's belief about the **efficiency** of AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
H2.3	The relationship between **a customer's knowledge** about AI and a customer's **openness** to use AI-enabled products/services is **mediated by his/her** belief about the **efficiency** of AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
	Hypothesis 3: *Convenience*	**Supported**
H3.1	There is a positive relationship between a customer's belief about the **convenience** of AI-enabled products/services and a customer's **openness** to use AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
H3.2	There is a positive relationship between a customer's **knowledge** about AI and his/her belief about the **convenience** of AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
H3.3	The relationship between **a customer's knowledge** about AI and a customer's **openness** to use AI-enabled products/services is **mediated by** his/her belief about the **convenience** of AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
	Hypothesis 4: *Privacy Protection*	**Supported**
H4.1	There is a positive relationship between a customer's belief about his/her **privacy protection** when using AI-enabled products/services and a customer's **openness** to use AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
H4.2	There is a positive relationship between a customer's **knowledge** about AI and his/her belief about **privacy protection** when using AI-enabled products/services.H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
H4.3	The relationship between **a customer's knowledge** about AI and a customer's **openness** to use AI-enabled products/services is mediated by his/her her belief about **privacy protection** when using AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Supported
	Hypothesis 5: *Data Security*	**Not supported**
H5.1	There is a positive relationship between a customer's belief about the **data security** of AI-enabled products/services and a customer's **openness** to use AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Not supported
H5.2	There is a positive relationship between a customer's **knowledge** about AI and a customer's belief about the **data security** of AI-enabled products/services.H_0: $\beta = 0$, H_1: $\beta > 0$	Not supported
H5.3	The relationship between a **customer's knowledge** about AI and a customer's **openness** to use AI-enabled products/services is **mediated by his/her** belief about the **data security** of AI-enabled products/services. H_0: $\beta = 0$, H_1: $\beta > 0$	Not supported

10 Figures

Figure 1: Conceptual Model

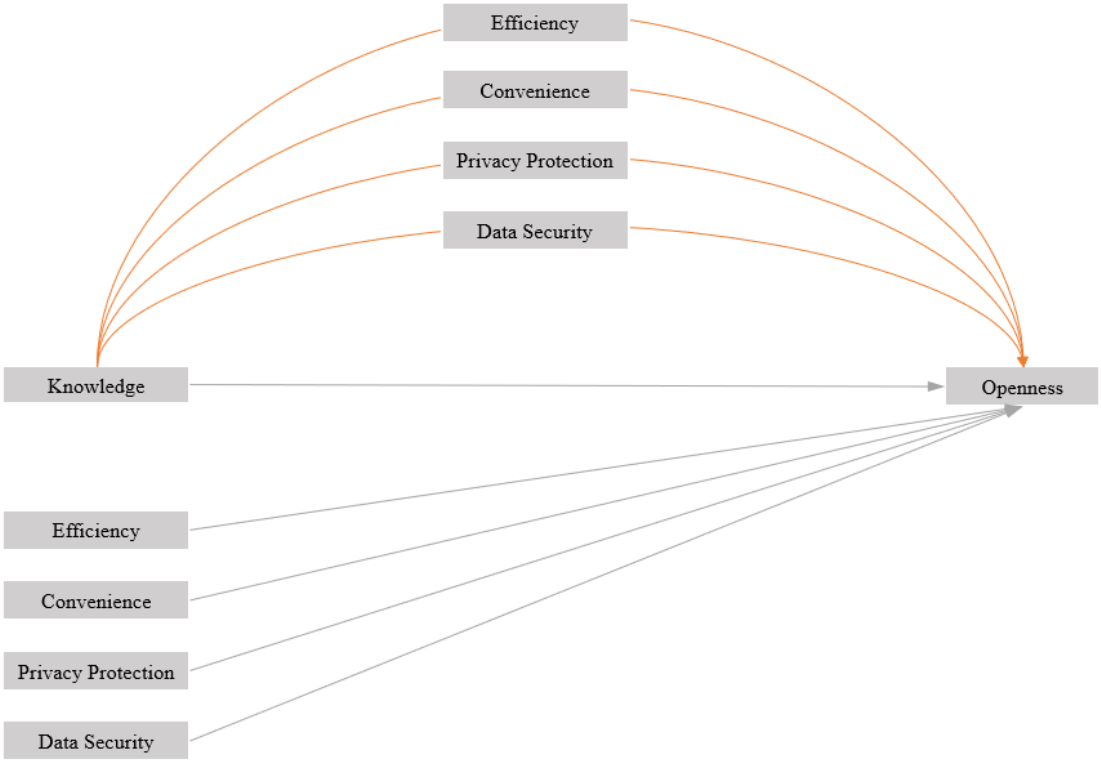


Figure 2: Model 1 - The effect of Knowledge on Openness

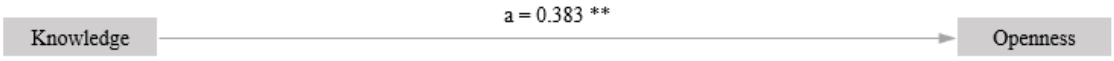


Figure 3: Model 2 - The effect of Knowledge on Efficiency, Convenience, Privacy Protection and Data Security

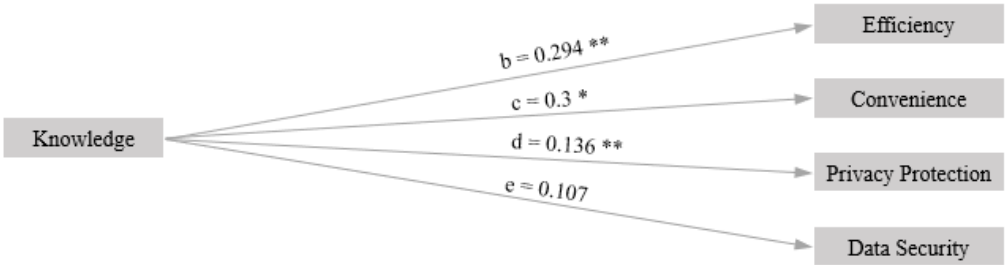
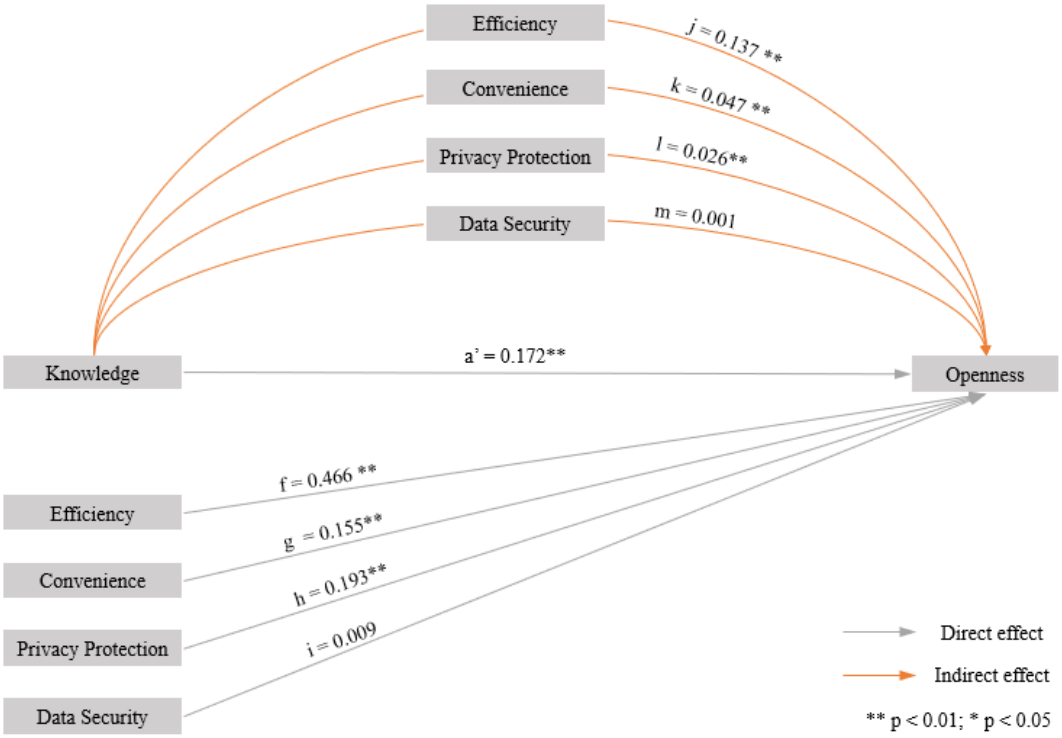


Figure 4: Model 3 - The direct and indirect effects of Knowledge, Efficiency, Convenience, Privacy Protection and Data Security on Openness



11 Appendix

Appendix 1: Original version of survey (English)

Q1 Dear survey participants, my name is Jana Lautenschläger and I am currently studying International Management at Nova School of Business and Economics in Lisbon, Portugal. For my master thesis I examine customers openness related to products and services that use Artificial Intelligence technology. The following survey addresses anyone who is a customer in the broadest sense and as such interacts with products and services from various industries. For the purpose of this survey, AI is defined as machines being able to perform cerebral functions that are typically associated with human minds, such as learning, perceiving, problem solving and decision making, as well as performing physical tasks (Cam et al., 2019). The survey will take around 9-10 minutes. The data of this survey will be treated anonymously and not forwarded to third parties. The questions do not allow making conclusions about the survey participant. I appreciate your support for my master thesis. Please feel free to contact me in case you have any questions. Jana Lautenschläger (39735@novasbe.pt)	
Q2	Is your study background or your job related to STEM (Science, Technology, Engineering, Mathematics)?
Q3	Which statement describes your knowledge about Artificial Intelligence, best?
Q4	Which of the following can Artificial Intelligence **currently** do? (Check all that apply)
Q5	Have you interacted with Artificial Intelligence Technology in the past 30 days?
Q6	Which of the following technologies have you interacted with, in the past 30 days? (Check all that apply)
Q7 **Please take a minute to read this explanation:** To put it simply, Artificial Intelligence (AI) involves algorithms that can do things which previously only humans could do. The difference between normal programming and AI is that in a "normal program" all scenarios have been defined beforehand - thus, the program runs on pre-determined scenarios. Artificial Intelligence analyzes data and can improve itself, on its own. It can predict outcomes or find patterns that the human eye could not see. For the remainder of this survey, keep in mind that Artificial Intelligence will be abbreviated as "AI" and is defined as follows: **AI can be thought of as machines being able to perform cerebral functions that are typically associated with human minds, such as learning, perceiving, problem solving and decision making, as well as performing physical tasks (Cam et al., 2019)** A simple example of Artificial Intelligence - recommended movies on Netflix: Netflix analyzes the series and movies that you and other people with similar preferences, have	

watched in the past. As such, it recommends different movies and series to everyone, based on their unique preferences. Whenever you watch another movie or series, the algorithm gets to know you a little better. More advanced examples of the use of AI are autonomous (driverless) cars and use cases in the healthcare sector: Your doctor could run a PET scan (imaging test that reveals how your tissues and organs are functioning) and allow an AI algorithm to analyze the images. The algorithm could for example predict Alzheimer's disease about 10 years before first symptoms arise.	
Q8	I am open to use products/services that use AI technology in my everyday life.
Q9	If companies are transparent about using AI in their products/services, I am more open to use those. ***[excluded]***
Q10	I am concerned about my privacy, when using AI-driven products/services.
Q11	I intend to use products/services that use AI in my everyday life.
Q12	My data are protected less if I use products/services that employ AI.
Q13	By using AI driven products/services I feel like companies know everything about me and "listen" all the time.
Q14	Products/services that employ AI are always available for me - 24/7. ***[excluded]***
Q15	The more companies use AI in their products/services, the less privacy I have.
Q16	I do not care about companies being open to me about using AI in their products/services. ***[excluded]***
Q17	I believe that AI powered products/services make my everyday life more efficient by eg. helping me to find the best route to any destination.
Q18	I intend to use products/services that use AI, regularly.
Q19	I believe that my data are protected less if companies deploy AI in their products/services.
Q20	I expect to receive more personalized recommendations via products/services that use AI.
Q21	AI powered products/services help me to spend less time waiting.
Q22	I am looking forward to interacting with more products/services that are powered by AI.
Q23	I expect organizations to let me know if their products/services use AI. ***[excluded]***
Q24	I believe that AI driven products/services can give me answers to complex questions.
Q25	AI driven products/services can protect my data well.
Q26	AI driven products/services help me to save time.
Q27	I believe that AI driven products/services help me to get the best deals for my purchases.
Q28	AI enabled products/services give me easier access to information.
Q29	What is your nationality?
Q30	How old are you?
Q31	What is your gender?
Q32	Do you have any comments or questions?
Q33	Feel free to leave your e-mail address in case you would like to receive the results of my thesis!

Appendix 2: German version of the survey

Q1 Sehr geehrte Umfrageteilnehmer,

Mein Name ist Jana Lautenschläger und ich studiere derzeit International Management an der Nova School of Business and Economics in Lissabon, Portugal.

In meiner Masterarbeit untersuche ich die Offenheit von Kunden in Bezug auf Produkte und Dienstleistungen, die künstliche Intelligenz verwenden. Die folgende Umfrage richtet sich an alle, die im weitesten Sinne Kunden sind und als solche mit Produkten und Dienstleistungen aus verschiedenen Branchen interagieren. Für die Zwecke dieser Umfrage wird KI als "Maschinen" definiert, die in der Lage sind, Gehirnfunktionen auszuführen, die typischerweise mit dem menschlichen Verstand verbunden sind, wie z. B. Lernen, Wahrnehmen, Problemlösen und das Treffen von Entscheidungen, sowie das Ausführen körperlicher Aufgaben (Cam et al., 2019). Die Umfrage dauert ca. 9-10 Minuten. Die Daten dieser Umfrage werden anonym behandelt und nicht an Dritte weitergegeben. Die Fragen erlauben keine Rückschlüsse auf den Umfrageteilnehmer.

Ich freue mich über Ihre Unterstützung für meine Masterarbeit. Bei Fragen stehe ich Ihnen gerne zur Verfügung.

Jana Lautenschläger (39735@novasbe.pt)

Q2	Steht Ihre Studien- oder Berufserfahrung im Zusammenhang mit MINT (Mathematik, Ingenieurwesen, Naturwissenschaften, Technik)?
Q3	Welche Aussage beschreibt Ihr Wissen über Künstliche Intelligenz am besten?
Q4	Welche der folgenden Fähigkeiten hat Künstliche Intelligenz momentan? (Zutreffendes bitte ankreuzen)
Q5	Haben Sie in den letzten 30 Tagen mit Künstlicher Intelligenz interagiert?
Q6	Mit welchen der folgenden Technologien haben Sie in den letzten 30 Tagen interagiert? (Zutreffendes bitte ankreuzen)

Q7 **Bitte nehmen Sie sich eine Minute Zeit, um diese Erklärung zu lesen:**

Um es einfach auszudrücken: Künstliche Intelligenz (KI) umfasst Algorithmen, die Dinge tun können, die bisher nur Menschen tun konnten. Der Unterschied zwischen normaler Programmierung und KI besteht darin, dass in einem "normalen Programm" alle Szenarien zuvor definiert wurden - das Programm läuft also in vordefinierten Szenarien. Künstliche Intelligenz analysiert Daten und kann sich selbst verbessern. Es kann Ergebnisse vorhersagen oder Muster finden, die das menschliche Auge nicht sehen konnte.

Beachten Sie für den Rest dieser Umfrage die Abkürzung von künstlicher Intelligenz als "KI" und folgende Definition: **KI kann als Maschinen betrachtet werden, die in der Lage sind, Gehirnfunktionen auszuführen, die typischerweise mit dem menschlichen Verstand verbunden sind, wie z. B. Lernen, Wahrnehmen, Problemlösen und das Treffen von Entscheidungen sowie das Ausführen körperlicher Aufgaben (Cam et al., 2019).**

Ein einfaches Beispiel für künstliche Intelligenz - empfohlene Filme auf Netflix: Netflix analysiert die Serien und Filme, die Sie und andere Personen mit ähnlichen Vorlieben in der Vergangenheit gesehen haben. Aus diesem Grund werden jedem unterschiedliche Filme und Serien empfohlen, basierend auf seinen individuellen Vorlieben. Immer wenn Sie einen anderen Film oder eine andere Serie sehen, lernt der Algorithmus Sie ein wenig besser kennen.

Fortgeschrittenere Beispiele für die Verwendung von KI sind autonome (fahrerlose) Autos und Anwendungsfälle im Gesundheitswesen: Ihr Arzt könnte einen PET-Scan durchführen (Bildgebungstest der zeigt, wie Ihre Gewebe und Organe funktionieren) und einem KI-Algorithmus die Analyse der Bilder überlassen. Der Algorithmus könnte beispielsweise die Alzheimer-Krankheit etwa 10 Jahre vor dem Auftreten der ersten Symptome vorhersagen.	
Q8	Ich bin offen dafür, Produkte/Dienstleistungen die KI nutzen, in meinem Alltag zu verwenden.
Q9	Wenn Unternehmen transparent über die Verwendung von KI in ihren Produkten/Dienstleistungen sind, bin ich offener diese zu nutzen. ***[excluded]***
Q10	Ich bin über meine Privatsphäre besorgt, wenn ich KI-gesteuerte Produkte/Dienstleistungen verwende.
Q11	Ich beabsichtige in meinem Alltag Produkte/Dienstleistungen zu nutzen, die KI verwenden.
Q12	Wenn ich KI getriebene Produkte/Dienstleistungen verwende, sind meine Daten weniger geschützt.
Q13	Durch die Nutzung KI getriebener Produkte/Dienstleistungen, habe ich das Gefühl, dass Unternehmen alles über mich wissen und die ganze Zeit "zuhören".
Q14	Produkte/Dienstleistungen die KI verwenden, stehen mir immer zur Verfügung - rund um die Uhr. ***[excluded]***
Q15	Je stärker Unternehmen KI in ihren Produkten/Dienstleistungen einsetzen, desto weniger Privatsphäre habe ich.
Q16	Es ist mir egal, ob Unternehmen offen darüber sind, dass sie KI in ihren Produkten/Dienstleistungen einsetzen. ***[excluded]***
Q17	Ich glaube, dass KI getriebene Produkte/Dienstleistungen meinen Alltag effizienter machen, da sie mir z.B. helfen die beste Route zu einem Ziel zu finden.
Q18	Ich beabsichtige, regelmäßig Produkte/Dienstleistungen zu nutzen, die KI verwenden.
Q19	Ich glaube, dass meine Daten weniger gut geschützt sind, wenn Unternehmen KI in ihren Produkten/Dienstleistungen einsetzen.
Q20	Ich erwarte mehr personalisierte Empfehlungen durch Produkte/Dienstleistungen die KI nutzen.
Q21	KI getriebene Produkte/Dienstleistungen helfen mir, weniger Zeit mit Warten zu verbringen.
Q22	Ich freue mich darauf, mit weiteren Produkten/Dienstleistungen zu interagieren, die auf künstlicher Intelligenz basieren.
Q23	Ich erwarte von Organisationen, dass sie mich wissen lassen, ob ihre Produkte/Dienstleistungen KI verwenden. ***[excluded]***
Q24	Ich glaube, dass KI getriebene Produkte/Services mir Antworten auf komplexe Fragen geben können.
Q25	KI getriebene Produkte/Dienstleistungen können meine Daten gut schützen.
Q26	KI getriebene Produkte/Dienstleistungen helfen mir, Zeit zu sparen.
Q27	Ich glaube, dass KI getriebene Produkte/Dienstleistungen mir helfen, die besten Angebote für meine Einkäufe zu bekommen.
Q28	Produkte/Dienstleistungen die KI nutzen, erleichtern mir den Zugang zu Informationen.
Q29	Was ist Ihre Nationalität?
Q30	Wie alt sind Sie?
Q31	Was ist Ihr Geschlecht?
Q32	Haben Sie Kommentare oder Fragen?
Q33	Falls Sie anschließend die Ergebnisse meiner Masterarbeit erhalten möchten, hinterlassen Sie bitte Ihre E-Mail-Adresse!